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Distribution extension and ecological aspects of one Trichomycteridae species in a tropical river, Amazon, Brazil

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ABSTRACT

Fishes of the family Trichomycteridae are widely distributed in South America, but there are knowledge gaps in the distribution range of some species, mainly in the western of the Brazilian Amazon. Here, we present new records of *Pseudostegophilus nemurus* in the Acre State, Brazil, and provide information on growth and diet. Specimens were collected from August to September 2017 in 12 beaches along the Acre River. Twenty individuals were analyzed, with total length and total weight of 105.28 ± 27.82 mm and 5.89 ± 1.01 g, respectively. Five food items were identified, with fish scales (60%) being the most representative and sand (65%) the accessory item. The specie showed negative allometric growth (b = 2.56). Knowledge about the diversity of many areas of the Amazon is still incipient, and information about the distribution extension and natural history of the species are important for future studies in this biome.

Keywords: Acre River; ichthyofauna; lepidophagus; neotropical region; weight-length relationship.

Extensão da distribuição e aspectos ecológicos de uma espécie de Trichomycteridae em um rio tropical, Amazônia, Brasil

RESUMO

Os peixes da família Trichomycteridae são amplamente distribuídos na América do Sul, mas existem lacunas de conhecimento sobre a distribuição de algumas espécies, principalmente no oeste da Amazônia brasileira. Aqui, apresentamos novos registros de *Pseudostegophilus nemurus* no Estado do Acre, Brasil, e fornecemos informações sobre crescimento e dieta. Os espécimes foram coletados entre agosto e setembro de 2017 em 12 praias ao longo do rio Acre. Foram analisados 20 indivíduos, com tamanho total e comprimento total de 105,28 ± 27,82 mm e 5,89 ± 1,01 g, respectivamente. Foram identificados cinco itens alimentares, sendo escamas de peixes (60%) o mais representativo e areia (65%) o item acessório. A espécie apresentou crescimento alométrico negativo (b = 2,56). O conhecimento sobre a diversidade de muitas áreas da Amazônia são incipientes, e informações sobre a ampliação de distribuição e a história natural das espécies são importantes para estudos futuros neste bioma.

Palavras-chave: Rio Acre, ictiofauna, lepidofagia, região Neotropical, relação peso-comprimento.

Introduction

The Neotropical region has the largest fish biodiversity in the world, and the Amazon basin is notably the richest, represented mainly by the orders Characiformes, Siluriformes, Gymnotiformes and Cichliformes (LÉVÊQUE et al., 2008; STEELE; LÓPEZ-FERNÁNDEZ, 2014; REIS et al., 2016; RAMOS et al., 2018). The order Siluriformes consists of 39 families, 477 genera and 6594 valid species (FRICKE et al., 2018). The family Trichomycteridae presents 307 described species, with wide distribution, occurring from Costa Rica to Patagonia (DONASCIMIENTO; PROVENZANO, 2006; FRICKE et al., 2018). In the Amazon region, species of Trichomycteridae are popularly known as candirus and may be parasitic or hemiparasite, most of them hematophagous, while some species have lepidophageal behavior (BASKIN et al., 1980; WINEMILLER; YAN, 1989; DE PINNA; BRITSKI, 1991). The genus *Pseudostegophilus* (Eigenmann & Eigenmann 1889) is represented by two species: *Pseudostegophilus haemomyzon* (Myers 1942) and *Pseudostegophilus nemurus* (Günther 1869), which are characterized by their deeply forked caudal fin and thin extremities (NELSON et al., 2016). The *P. nemurus* species differs from others because it exhibits a dark banded color pattern along the body and an upper caudal lobe with a simple filament (BURGESS, 1993; DE PINNA; ZUANON, 2013), and its distribution ranges from rivers in Venezuela to the Amazon basin (DE PINNA; WOSIACKI, 2003). In order to fill the knowledge gap about this species, this study presents a distribution expansion of *P. nemurus* and provides information on weight-length relationship and diet.

Materials and Methods

The fieldwork was carried out along 300 km of the Acre River, between the municipalities of Brasiléia (11°1'1.56"S, 68°44'38.51"W) and Rio Branco (10°9'21.84"S, 67°49'4.86"W), state of Acre, Brazil, between August and September 2017 (Figure 1a). Thirty shallow beaches were sampled, with an average distance of 10 kilometers between them (Figure 1b). The beaches varied in relation to the characteristics of the vegetation in the river edge. In the upper portion (near the municipality of Brasiléia), vegetation was mainly composed of shrubs and grasses. In the most central region, the edges showed a higher level of preservation of native vegetation, with few farms and residences. In the beaches located in the lower portion, the edges had little vegetation and a high level of degradation due to anthropic activities, generated by cattle ranches and sand dredges. For fish collection, a trawl 9 m long, 2 m high and 5 mm mesh between opposite nodes was used. The trawl net was passed three times on each of the 30 sampled beaches during two periods: daytime (06:00 to 10:00) and nighttime (18:00 at 21:00). The captured fish were anesthetized with Eugenol (KEENE et al., 1998), then fixed in 10% formalin and after 24 hours were transferred to 70% ethanol. Identification was performed based on specialized bibliography (DE PINNA, 1992; DE

DE PINNA; ZUANON, 2013). Voucher specimens were deposited in the Ichthyological Collection of the Federal University of Acre (MUFAC-IC1208). In the laboratory, the measurements of total length (mm) and total weight (g) were taken, and then the stomach contents were removed. Food items were identified to the lowest possible taxonomic level using stereoscopic and optical microscopes with specialized bibliography, and the frequency of occurrence (%FO) was quantified, which corresponds to the percentage of the total number of stomachs in which a given food item is found (HYSLOP, 1980). The scales found in the stomachs were compared with the scales of the other species that occurred on the sampled beaches.

A total of 18 morphometric variables were measured according to the study of de Pinna (1992) (Table 1). For the weight-length relationship (LRWs) we used the following equation (LE CREN, 1951; FROESE, 2006): $W = aL^b$, where W is the total weight and L is the total length, where a and b are the model constants. Parameters a and b by linear regression according to the formula: $logW = log\ a + b\ logL$, using the PAST 3.1 statistical program (HAMMER et al., 2001).

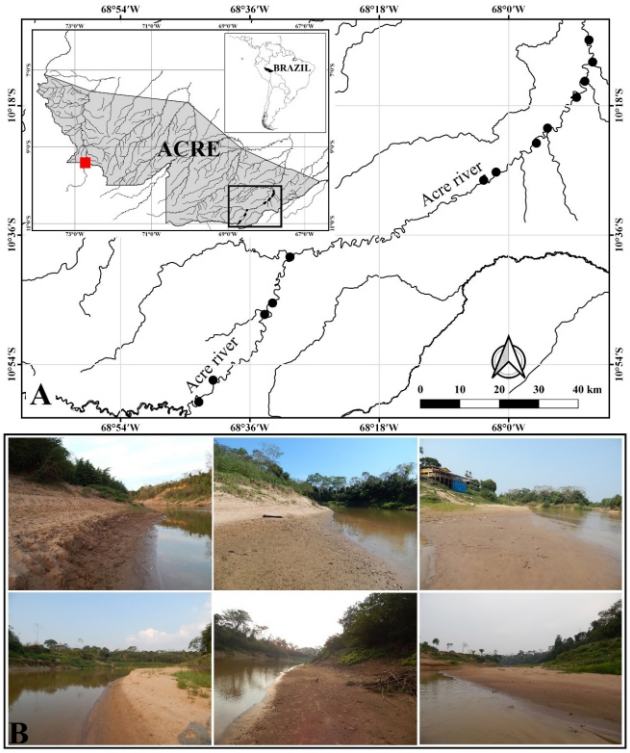

Figure 1. (A) Latin America, State of Acre, Brazil, and locality where *P. nemurus* was previously registered (red square – CARVALHO et al., 2009), new records of *P. nemurus* collected along the Acre River (black square); (B) photos of some beaches of the Acre river.

Results

Twenty individuals of *P. nemurus* (Figure 2) were collected from 12 (40%) of the 30 sampled beaches. The specimens had a total average length of 105.28 mm (± 27.82 mm) and a total average weight of 5.89 g (± 1.01 g). Five types of food items were identified, being the accessory sand item the most representative (%FO = 65.0), followed by scales (%FO = 60.0), mucus (%FO = 25.0), unidentified food item (%FO = 20.0) and organic matter (%FO = 10.0). The comparison of the scales found in the diet allowed the identification of two species: *Thoracocharax stellatus* (Kner 1858) (Figure 3a) and *Triportheus albus* (Cope 1872) (Figure 3b). The result of the LRWs was: b = 2.56; LC = 2.37 - 2.79; a = 0.007; LC = 0.002 - 0.075; r^2 = 0.975; $p < 0.01$. New records the specie include: Brazil, State of Acre, Municipality of Assis Brasil, August 8, 2017 (11°00'88.6 "S, 068°44'41.4"W); Xapuri, 17 August 2017 (10°41'42.3"S, 068°31'11.2"W); Senador Guiomard, 13 September 2017 (10°19'41.9"S, 067°52'40.1"W); Rio Branco, September 17, 2017 (10°08'52.8"S, 067°48'50.6"W). The specimens found in the Acre River match the diagnostic features for *Pseudostegophilus nemurus*, as clearly observed in the photo (Fig. 2). These diagnostic features include: six rows of labial teeth, rhomboid in shape; well-defined dark vertical spots, which cross the dorsum and the upper lateral regions; extremely forked caudal fin and thin ends, with a filament extending from the upper lobe.

Table 1. Morphometric data of 20 *P. nemurus* individuals collected from Acre river beaches, Brazil. SD = standard deviation.

Measurements	Min	Max	Mean
Total length	65.00	157.32	105.28±27.82
Standard length	44.41	115.12	71.09±18.96
Head height	5.02	11.16	7.10±1.98
Bodyheight	7.42	18.82	12.91±1.63
Caudal peduncleheight	3.44	11.90	6.11±2.17
Anal fin base length	3.38	8.97	6.21±1.45
Dorsal fin base length	2.89	12.35	8.44±2.46
Anal finlength	5.25	14.01	9.95±2.39
Dorsal finlength	7.40	17.20	11.57±2.64
Caudal pedunclelength	7.61	32.21	13.59±5.61
Head length	8.90	18.52	13.20±3.17
Muzzlelength	2.78	13.45	5.28±2.35
Eyediameter	1.30	13.38	2.96±2.53
Interorbital distance	3.31	8.26	5.65±1.70
Pre-analdistance	33.31	76.33	50.70±12.59
Pre-dorsaldistance	25.37	61.58	41.48±10.70
Pre-pelvicdistance	25.41	58.14	39.19±9.62
Head width	8.92	19.44	13.46±3.44

Figure 2. Specimen of *Pseudostegophilus nemurus* (TL: 147 mm) collected from a beach of the Acre River basin, State of Acre, Brazil. (Photo by Ronaldo Souza).

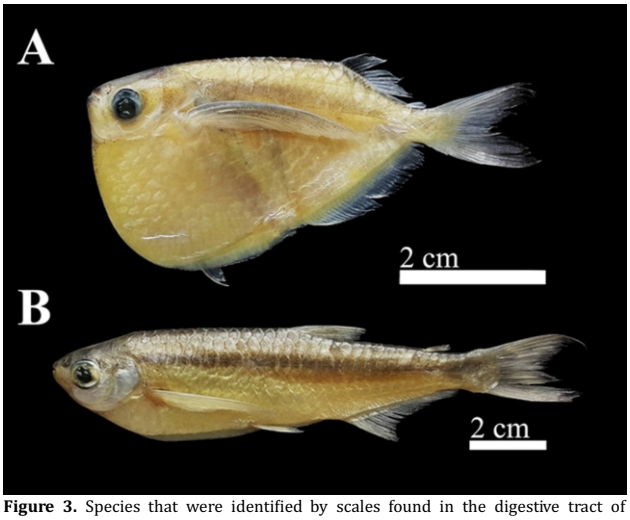

Figure 3. Species that were identified by scales found in the digestive tract of *Pseudostegophilus nemurus*, (A) individual of *Thoracocharax stellatus* and (B) individual of *Triportheus albus* collected on a sandy beach of the Acre River, Brazil. (Photo by Ronaldo Souza).

Discussion

In this study we expanded the distribution of *P. nemurus* over 400 km southeast in the state of Acre, Brazil (BEGOSSI et al., 1999; SILVANO et al., 2000). In another record in Brazil, the species was found in the Madeira River, over 700 km away from the Acre River (DE PINNA; ZUANON, 2013; QUEIROZ et al., 2013), while in Bolivia it was recorded over 150 km away for the south (YUNOKI et al., 2013), and in Peru was recorded in the upper Juruá River (CARVALHO et al., 2009; DE PINNA; ZUANON, 2013), more than 500 km away from our sampled sites. The establishment of the

correct limits for the distribution is essential for increase knowledge about species and to study geographic biodiversity patterns (JETZ et al., 2019). The greater presence of the scale as food item allows the species to be classified as a lepidophagus, which is also evidenced by the morphological aspects of the buccal apparatus, that can fix and tear the scales of the preys. Lepdophagy is a trophic category presented by different taxonomic groups [e.g. *Exodon paradoxus* (Müller & Troschel 1844), *Roeboides prognathus* (Boulenger 1895), *Catoprion mento* (Cuvier 1819), *Henonemus punctatus* (Boulenger 1887), *Corematodus shiranus* (Boulenger 1897)], which highlights the importance of scales in the feeding of many species (SAZIMA, 1983; DE PINNA, 1992). During the night the fishes are more susceptible to the attack of *P. nemurus* because this species has greater activity in this period (SAZIMA, 1983; DE PINNA; ZUANON, 2013). The species identified as preys of *P. nemurus* in the present study (*T. albus* and *T. stellatus*) are very abundant in tropical river beach environments (DUARTE et al., 2010). The result of the LRWs (b = 2.56) is within the acceptable range of 2.5-3.5 (see FROESE, 2006), and is classified as negative allometric, indicating greater increase in length than in weight, consistent with the values expressed by FishBase (FROESE; PAULY, 2019). Studies of distribution expansion and ecological aspects are important for the description and evaluation of local aquatic biodiversity, enabling more complex ecological studies.

Conclusions

Knowledge about the diversity of many areas of the Amazon is still incipient, and both the distribution extension and the description of new species are important information for future studies in this biome.

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